

Information Systems Outsourcing Adoption

por

Ricardo José dos Santos Martins

Proposta de dissertação apresentada como requisito  
parcial para admissão a fases seguintes no percurso na obtenção do grau de

Mestre em Estatística e Gestão de Informação

pelo

Instituto Superior de Estatística e Gestão da Informação

da

Universidade Nova de Lisboa

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Professor orientador:  
Professor Doutor Tiago Oliveira

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À minha família

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## **Abstract**

Information systems outsourcing (ISO) is the management of information systems operations performed by an external organization. It has an enormous potential and capability to improve business processes and technological innovations for companies. However, the adoption rates of ISO are still lower than expected. It is therefore desirable to make more efforts to identify determinants of ISO adoption. Based on the combination of a technology-organization-environment (TOE) framework and diffusion of innovation (DOI) theory, we develop a conceptual model to study the determinants of the ISO adoption. Data collected from 261 firms in Portugal were used to test the proposed research model. Based on logistic regression we find five contextual factors (relative advantage, firm size, top management support, perceived benefits, and competitive pressure) to be determinants of ISO adoption. Among them, perceived benefits was found to be the most significant driver, followed by competitive pressure. Overall, these results indicate that the adoption of ISO is affected mainly by the organizational context, compared to the remaining contexts proposed (technology, environment, and individual leader characteristics). These findings are particularly useful for managers, suppliers, and academics, since they provide important insights when focusing mostly on the organizational field.

### **Keywords:**

Information systems outsourcing (ISO); information technology outsourcing (ITO); technology-organization-environment (TOE); diffusion of innovations (DOI); technology adoption.

## Resumo

O outsourcing dos sistemas de informação (ISO) é a gestão das operações dos sistemas de informação levada a cabo por uma empresa externa à organização. Tem um enorme potencial e capacidade para melhorar os processos de negócios e inovações tecnológicas das empresas. No entanto, os níveis de adopção do ISO ainda são menores do que o esperado. Por isso, é desejável empreender esforços acrescidos para identificar os determinantes para a adopção do ISO. Baseado na combinação dos modelos tecnologia-organização-ambiente (TOE) e difusão da inovação (DOI), desenvolvemos um modelo conceptual para estudar os determinantes da adopção do ISO. Os dados recolhidos de 261 empresas, com actividade em Portugal, foram usados para testar o modelo de investigação proposto. Com base na regressão logística, identificámos cinco factores contextuais (vantagem relativa, dimensão da empresa, apoio da gestão de topo, benefícios percebidos e pressão competitiva) como determinantes para a adopção do ISO. Entre eles, os benefícios percebidos foram identificados como sendo o factor mais significativo, seguido da pressão competitiva. No geral, estes resultados indicam que a adopção do ISO é afectada principalmente pelo contexto organizacional, comparativamente com os restantes contextos propostos (tecnologia, ambiente e características individuais do líder). Estas conclusões são particularmente úteis para os gestores, fornecedores e académicos, uma vez que fornecem perspectivas importantes ao focar o campo organizacional.

### Palavras-chave:

Outsourcing dos sistemas de informação (ISO); outsourcing das tecnologias de informação (ITO); tecnologia-organização-ambiente (TOE); Difusão da Inovação (DOI); adopção da tecnologia.

## **Publications**

### **List of publications resulting from this dissertation**

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## **Abbreviations**

ISO – Information Systems Outsourcing  
TOE – Technology, Organization, and Environment  
DOI – Diffusion of Innovations  
ITO – Information Technology Outsourcing  
BPO – Business Process Outsourcing  
IT – Information Technology  
ASP – Application Service Provision  
ERP – Enterprise Resource Planning  
CRM – Customer Relationship Management  
VM – Virtualization  
SaaS – Software as a Service  
PaaS – Platform as a Service  
IaaS – Infrastructure as a Service  
EDI – Electronic Data Interchange  
RFID – Radio Frequency Identification  
IS – Information Systems  
KMO – Kaiser-Meyer-Olkin  
PB – Perceived Benefits  
RA – Relative Advantage  
TMS – Top Management Support  
C – Complexity  
TR – Technology readiness  
FS – Firm Size  
ATC – Attitude Toward Change  
CP – Competitive Pressure  
RE – Regulatory Environment  
LR – Likelihood Ratio  
VIF – Variance Inflation Factor

AUC – Area Under the Curve

## 1. Introduction

Information systems outsourcing (ISO) is the business practice in which a company contracts outside the supply of its information systems operations [Hu et al., 1997]. The supplier's contribution could be in physical or human resources for all or a specific component of the information technology operations [Loh and Venkatraman, 1992a]. ISO has been described in the literature as a natural consequence of globalization and technological change [Zhu et al., 2001]. A greater range and depth of services are being outsourced, where current practices reflect the outsourcing of critical activities [Grover et al., 1996], and bundling practice of information technology outsourcing (ITO) and business process outsourcing (BPO) [Lacity et al., 2009]. On average, outsourcing does realize benefits for the service receiver [Grover et al., 1996], and depending on their capabilities and needs, many firms can profitably outsource almost any element in the innovation chain [Quinn, 2000]. This is one of the reasons why firms choose outsourcing [Dibbern et al., 2004]. However, despite the considerable amount of research that has been done over the last 20 years, the field continues to attract inquiry, a result of its continuing and rapid evolution [Lacity et al., 2010]. Also because of its rapid change, research must include ever more – and ever more specific – factors in order to understand ISO's adoption [Grover et al., 1996]. Moreover, because the growth of ISO does not match expectations, and given the investment that has been made by most suppliers based on those expectations, it is imperative to understand the factors that affect its adoption.

As part of the resolution of this issue, this study seeks to advance researchers' understanding of the determinants of ISO adoption. To achieve this, we develop a conceptual model based on the two most widely used firm-level adoption models, i.e., the technology-organization-environment (TOE) framework [Wang et al., 2010; Tornatzky and Fleischer, 1990] and diffusion of innovation (DOI) theory [Rogers, 1995], which taken together are considered to be consistent [Zhu et al., 2006a; Zhu et al., 2006b]. Our model combines these two. To the best of our knowledge, there is no published study that has made use of such a combination to understand ISO adoption.

The paper is organized as follows. Section 2 describes the background of ISO and reviews the literature on the TOE framework and DOI theory. Section 3 presents the research model developed herein along with hypotheses. Section 4 describes the methodology employed for data collection. Section 5 presents the data analysis and results. Sections 6 and 7 present the discussion and the conclusion, respectively.

## **2. Background**

### **2.1. ISO**

ISO has been defined in many ways by several authors [Dibbern et al., 2004]. However, a consensus prevails that outsourcing involves choosing a third party or an outside supplier to perform a task, function, or process, in order to incur business-level benefits [Sanders et al., 2007], i.e., the transfer of responsibility of a business activity or process to another entity [Zhu et al., 2001]. Hence, ISO is the significant contribution on the part of external vendors of the physical and/or human resources associated with the entire information technology (IT) infrastructure in the user firm or specific components of the IT infrastructure [Loh and Venkatraman, 1992a], where its evolution is reflected in the development of information systems in general [Dahlberg and Nyrrhinen, 2006].

Outsourcing is the umbrella term that includes a range of sourcing options that are external to the firm [Sanders et al., 2007]. Given the recent focus of academics on ISO using sourcing models, such as application service provision (ASP), business process outsourcing (BPO) [Lacity et al., 2009], and cloud computing, we here provide a brief overview of each concept. ASP is the renting supplier-owned resource delivered over the internet, which includes the enterprise resource planning (ERP), customer relationship management (CRM), and all types of e-commerce and e-business, among others [Kern et al., 2002]. BPO refers to a situation in which the supplier takes over the execution of a client's business processes in functions such as human resource management, finance, and accounting [Lacity et al., 2003]. This practice involves the

assumption of a responsibility by a service provider for a series of tasks, performed together, to achieve a specific goal [Currie et al., 2003]. It is one of the biggest business trends and highest growth sectors in IT [Willcocks and Feeny, 2006], and expectations for the continued growth remain high [Davenport, 2005]. Cloud computing is a new paradigm whereby several computing resources are made available over the Internet [Goscinski and Brock, 2010]. This new paradigm uses internet-based technologies to conduct business, and therefore is recognized as an important area for IT innovation and investment [Goscinski and Brock, 2010; Armbrust et al., 2010; Tuncay, 2010]. Clouds are designed to provide services to external users by providers that, in order to share their resources and capabilities, need to be compensated [Buyya et al., 2009].

Comprising new technologies such as virtualization (VM), software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) [Goscinski and Brock, 2010], this new paradigm could revolutionize the business scenario in different technological innovations for firms who adopt it [Tuncay, 2010]. VM is the running of applications based on different operating system environments on a single physical machine [Buyya et al., 2009]. SaaS describes the situation in which the provider of a service hosts and manages a given application in their own data center, making it available to multiple users over the web [Bhardwaj et al., 2010]. It is a process by which different software applications are provided by the ASP as a rental over the Internet, leveraging cloud infrastructure and services released [Low et al., 2011]. PaaS refers to the provision of facilities to support the entire application development, including the design, implementation, debugging, test, operation, and support of rich web applications and services on the Internet [Nezhad et al., 2009]. IaaS refers to providing an environment for running user built virtualized systems in the cloud, including network access, routing services, and storage [Bhardwaj et al., 2010].

In the last 20 years, several studies have been conducted on the topic, but as can be seen in Table 2.1, and to the best of our knowledge, no study has made use of the pairing of models proposed herein (TOE framework coupled with DOI theory) to understand the factors that affect ISO adoption. Loh and Venkatraman [1992a] focused their pioneering work on the determinants that lead to the adoption of ISO, using DOI theory, and remains one of the references most often cited by subsequent researchers [Dibbern et al., 2004]. Many other studies have followed using other theories. However,



despite the substantial number of works dedicated to the subject, due the dynamic nature of ISO, which shows so much diversity (in services and types of firms) in such a short time span, there is a need to develop new studies in order to stay abreast of the matter [Dibbern et al., 2004].

Table 2.1. *Theories of previous studies on the ISO adoption*

Authors	Theory
Loh and Venkatraman [1992a]	DOI
Loh and Venkatraman [1992b]	Economic
Grover [1994]	Resource based; strategic management
Loh [1994]	Agency; transaction cost
Quinn and Hilmer [1994]	Strategic management
Apte and Manson [1995]	Strategic management
Cheon et al. [1995]	Resource based; resource dependency; agency; transaction cost
Jurison [1995]	Transaction cost
Lacity and Willcocks [1995]	Transaction cost
Loh and Venkatraman [1995]	Transaction cost
Mcfarlan and Nolan [1995]	Strategic management
Teng et al. [1995]	Resource based; resource dependency; strategic management
Aubert et al. [1996]	Transaction cost
Goodstein et al. [1996]	Power politic
Heisekanen et al. [1996]	Transaction cost
Nam et al. [1996]	Strategic management; transaction cost
Nelson et al. [1996]	Agency; transaction cost
Ang and Cummings [1997]	Strategic management; transaction cost
Hu et al. [1997]	DOI
Sridhar and Balachandran [1997]	Agency
Wang et al. [1997]	Agency
Ang and Straub [1998]	Transaction cost
Beath and Walker [1998]	Resource based
Chalos and Sung [1998]	Agency

<b>DiRomualdo and Gurbaxani [1998]</b>	Strategic management
<b>Duncan [1998]</b>	Resource based; transaction cost
<b>Poppo and Zenger [1998]</b>	Resource based; agency; transaction cost
<b>Hancox and Hackney [1999]</b>	Strategic management; agency; transaction cost; exchange
<b>Quinn [1999]</b>	Strategic management
<b>Goles and Chin [2005]</b>	Relational exchange
<b>Miranda and Kim [2006]</b>	Transaction cost
<b>Gurbaxani [2007]</b>	Transaction cost
<b>Wang and Yang [2007]</b>	Hybrid multi-criteria

## 2.2. TOE

The TOE framework developed by Tornatzky and Fleischer [1990] is applied in our study of the adoption of technological innovation. Although ISO can be viewed as a business practice, literature reports that creativity and innovation are stimulated by multidisciplinary teams operating outside conventional organization structures [Garvin, 1993; Goldman and Gabriel, 2005; Inkpen, 1996; Leonard-Barton, 1995; Nonaka, 1991; Agelfalk and Fitzgerald, 2008]. Since ISO falls into a similar category, we propose that the TOE framework provides a good model to understand the determinants that affect its adoption, because, beyond the features already mentioned, it has many consistent empirical supports [Wang et al., 2010]. The TOE framework comprises three distinct contexts: technological, organizational, and environmental. The technological context covers the internal and external technologies relevant to the firm, which includes current practices and the internal equipment of the company [Starbuck, 1976], as well as the technologies that are available externally [Hage, 1980; Khandwalla, 1970]. The organizational context refers to the descriptive measures of the organization, such as its scope and size [Tornatzky and Fleischer, 1990; Oliveira and Martins, 2011]. Finally, the environmental context corresponds to the constraints and opportunities for technological innovation, which includes the various actors that may impact the decision process, such as regulators, customers, and suppliers [Tornatzky and Fleischer, 1990]. TOE is widely regarded in the literature as extremely useful in explaining the adoption of

technological innovations [Zhu et al., 2006a; Oliveira and Martins, 2011; Chau and Tam, 1997; Gibbs and Kraemer, 2004; Xu et al., 2004]. Table 2.2 shows selected studies on the adoption of innovation that have made use of the TOE framework. Although the factors applied to each study are from the same framework and are therefore similar, several authors have expressed concern and adapted them according to the particular innovation studied.

Table 2.2. *Previous studies based on TOE framework*

Authors	Innovation studied	Determinants
<b>Chau and Tam [1997]</b>	Open Systems	<ul style="list-style-type: none"> <li>❖ Technology: perceived benefits; perceived barriers; perceived importance of compliance of to standards; interoperability; interconnectivity.</li> <li>❖ Organization: complexity of IT infrastructure; satisfaction with existing systems; formalization on system development and management.</li> <li>❖ Environment: market uncertainly.</li> </ul>
<b>Kuan and Chau [2001]</b>	EDI	<ul style="list-style-type: none"> <li>❖ Technology: perceived direct benefits; perceived indirect benefits.</li> <li>❖ Organization: perceive financial cost; perceived technical competence.</li> <li>❖ Environment: perceived industry pressure; perceived government pressure.</li> </ul>
<b>Zhu et al. [2003]</b>	E-business	<ul style="list-style-type: none"> <li>❖ Technology: technology competence.</li> <li>❖ Organization: firm scope; firm size.</li> <li>❖ Environment: consumer readiness; competitive pressure; lack of trading partner readiness.</li> </ul>
<b>Gibbs and Kraemer [2004]</b>	E-commerce	<ul style="list-style-type: none"> <li>❖ Technology: technology resources.</li> <li>❖ Organization: perceived benefits; lack of organizational compatibility; financial resources; firm size.</li> <li>❖ Environment: external pressure; government promotion; legislation barriers.</li> </ul>
<b>Xu et al. [2004]</b>	Internet	<ul style="list-style-type: none"> <li>❖ Technology: technology competence.</li> <li>❖ Organization: firm size; global scope; enterprise integration.</li> <li>❖ Environment: competition intensity; regulatory environment.</li> </ul>
<b>Zhu et al. [2006b]</b>	E-business	<ul style="list-style-type: none"> <li>❖ Technology: technology readiness; technology integration.</li> <li>❖ Organization: firm size; global scope; managerial obstacles.</li> <li>❖ Environment: competitive intensity; regulatory environment.</li> </ul>
<b>Zhu et al. [2006a]</b>	E-business	<ul style="list-style-type: none"> <li>❖ Technology: relative advantage; compatibility, cost and security concern.</li> <li>❖ Organization: technology competency; organization size.</li> <li>❖ Environment: competitive intensity; partner readiness.</li> </ul>
<b>Hong and Zhu [2006]</b>	E-commerce	<ul style="list-style-type: none"> <li>❖ Technology: technology integration; web functionalities; EDI use.</li> <li>❖ Organization: web spending; perceived obstacles.</li> <li>❖ Environment: partner usage.</li> </ul>

<b>Zhang et al.</b> <b>[2007]</b>	IT usage	❖ Technology: IT infrastructure. ❖ Organization: IT management. ❖ Environment: e-government; government regulation and promotion.
<b>Wang et al.</b> <b>[2010]</b>	RFID	❖ Technology: relative advantage; complexity, compatibility. ❖ Organization: top management support; firm size; technology competence. ❖ Environment: competitive pressure; trading partner pressure; information intensity.

### 2.3. DOI

Diffusion is a special type of communication, the spread of new ideas, that essentially consists of the creation and sharing of information between participants in achieving a common understanding [Rogers, 1995]. The process of innovation in an organization is quite complex, the number of individuals involved and their attitude to innovation, which can range from favorable to unfavorable, means that not all opinions converge in the same direction during the decision process [Oliveira and Martins, 2011]. And due to the intrinsic feature of novelty in its content, this process is shrouded in uncertainty that can only be mitigated by finding more information that supports the decision. Hence, the decision on innovation is seen as a mental process through which an individual or unit trained for this responsibility, first approaches the idea to innovation and then develops an attitude toward it, which may lead to either its adoption or rejection [Rogers, 1995]. DOI theory, developed by Rogers [1995], is related to the organizational innovativeness, which is composed of the individual leader characteristics, internal characteristics of organizational structure, and the external characteristics of the organization. Individual (leader) characteristics describe the attitude toward change, internal organizational structure characteristics describe their degree of centralization, complexity, formalization, interconnectedness, organization slack, and size. There is a similarity between some of the factors that comprise the DOI theory [Rogers, 1995] and the TOE framework [Tornatzky and Fleischer, 1990], such as complexity and firm size. Finally, external environment describes the external characteristics of the organization with regard to the system openness [Oliveira and Martins, 2011]. Table 2.3 shows selected studies that use DOI theory. Once again, we

see the concern of the authors to adapt the different factors to the particular features of innovation under study, despite the fact that all are derived from the same theory.

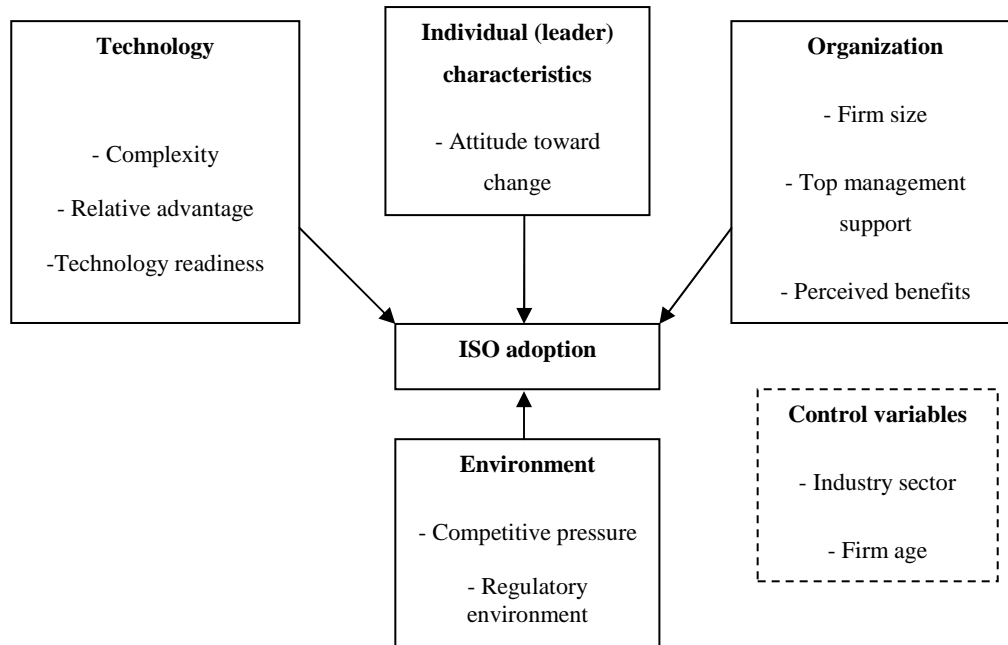
Table 2.3. *Previous studies based on the DOI theory*

Authors	Innovation studied	Determinants
<b>Thong [1999]</b>	IS adoption	<ul style="list-style-type: none"> <li>❖ CEO characteristics: CEO's innovativeness, CEO's knowledge.</li> <li>❖ Innovative characteristics: relative advantage of IS, compatibility of IS, complexity of IS.</li> <li>❖ Organizational characteristics: business size, employee's IS knowledge, information intensity.</li> <li>❖ Environmental characteristics: competition.</li> </ul>
<b>Eder and Igbaria [2001]</b>	Intranet	<ul style="list-style-type: none"> <li>❖ Earliness of adoption.</li> <li>❖ Top management support.</li> <li>❖ Organizational structure.</li> <li>❖ Organizational size.</li> <li>❖ IT infrastructure.</li> <li>❖ IS structure.</li> </ul>
<b>Bradford and Florin [2003]</b>	ERP	<ul style="list-style-type: none"> <li>❖ Innovative characteristics: technical compatibility, perceived complexity, business process reengineering.</li> <li>❖ Organizational characteristics: top management support; organizational objectives consensus, training.</li> <li>❖ Environmental characteristics: competitive pressure.</li> </ul>
<b>Chong et al. [2009]</b>	C-commerce	<ul style="list-style-type: none"> <li>❖ Innovation attributes: relative advantage, compatibility, complexity.</li> <li>❖ Organization readiness: top management support, feasibility, project champion characteristics.</li> <li>❖ Environmental: expectations of market trends, competitive pressure.</li> <li>❖ Information sharing culture: trust, information distribution, information interpretation.</li> </ul>

### 3. Research model and hypotheses

DOI theory [Rogers, 1995] is considered to be consistent with the TOE framework [Zhu et al., 2006a; Zhu et al., 2006b], and it is one of the most widely used in efforts to understand technology adoption [Wang et al., 2010], as the TOE framework renders DOI theory better able to explain the innovation diffusion [Hsu et al., 2006; Oliveira and Martins, 2010]. We propose a research model that combines both models, placing greater emphasis on the TOE framework. Figure 3.1 illustrates the conceptual research model. It is comprises four contexts: three (technology, organization, and

environment) from TOE framework and one (individual leader characteristics) from DOI theory. Based on these four contexts, we develop nine hypotheses to explain ISO adoption. The explanation for each hypothesis is presented below.



*Figure 3.1.* The research model for the ISO adoption study

### 3.1. Technology context

#### 3.1.1. Complexity

Complexity is the degree to which a given innovation is perceived as being difficult to understand or use [Corrocher, 2003; Rogers, 1995; Beatty et al., 2001]. Literature indicates that firms may be less likely to adopt an innovation or technology if it requires a high level of new skills for their employees [Beatty et al., 2001]. The perceived complexity of an innovation leads to resistance resulting from the lack of skills and knowledge [Rogers, 1983], and could jeopardize the adoption. This variable is reported in the literature as a factor inhibiting the implementation of innovation, and one that negatively influences its adoption [Tornatzky and Klein, 1982]. Thus, we propose the following hypothesis:

**H1.** Complexity will have a negative effect on the adoption of ISO.

### **3.1.2. Relative advantage**

Relative advantage refers to the degree to which a particular innovation is perceived as being able to provide greater organizational benefit [Rogers, 1983]. This variable has been identified as a significant driver for IT innovations usage [Premkumar et al., 1994; Iacovou et al., 1995]. Furthermore, the literature reports a positive relationship between relative advantage and IT adoption [Tornatzky and Klein, 1982]. Thus, the following hypothesis is proposed:

**H2.** Relative advantage will have a positive effect on adoption of ISO.

### **3.1.3. Technology readiness**

Technology readiness refers to the infrastructure of information technologies, as well as IT professionals [Zhu and Kraemer, 2005]. IT professionals are people within the organization who have expertise to implement the innovation. The IT infrastructure refers to the installed technologies, systems, and applications [Ngai et al., 2007]. Technology readiness reflects not only the physical assets, but additional human resources as well [Mata et al., 1995]. Since ISO is the outsourcing of these assets [Loh and Venkatraman, 1992a], and despite the adoption of other innovations, this factor may have a positive influence [Zhu and Kraemer, 2005]. In this study we will assume that the higher the level of technology readiness of an organization, the less likely it will be to adopt ISO. Thus, we propose the following hypothesis:

**H3.** Technology readiness will have a negative effect on the adoption of ISO.

### **3.2. Organization context**

#### **3.2.1. Firm size**

Firm size is an indicator of the firm's resources and an important factor that influences innovation adoption [Tornatzky and Fleischer, 1990]. It is defined as an organizational attribute to the diffusion of innovation [Rogers, 1995], and is measured by the number of employees and the number of establishments [Cho, 2006]. The existence of a positive relationship between firm size and adoption of technological innovation has been detected, as larger firms are more likely to make this kind of investment [Zhu et al., 2003; Quadros et al., 2001; Majumdar, 1995]. The following hypothesis is proposed:

**H4.** Firm size will have a positive effect on adoption of ISO.

#### **3.2.2. Top management support**

Top management support has been identified in the literature as a factor that positively affects the adoption of technological innovation [Grover et al., 1996], providing the vision, support, and commitment needed to foster the desired environment for the adoption of innovation [Lee and Kim, 2007]. In fact, in almost all innovative endeavors, top management support is extremely important [Beatty et al., 2001], and it will help focus efforts toward the realization of organizational benefits and lend credibility to functional managers responsible for its implementation and use [Bradford and Florin, 2003]. Since ISO is seen as a strategic decision [DiRomualdo and Gurbaxini, 1998], this factor can positively affect the adoption of innovation, creating an environment of greater convergence of ideas [McGowan and Madey, 1998]. Thus, we propose the following hypothesis:

**H5.** Top management support will have a positive effect on adoption of ISO.



### **3.2.3. Perceived benefits**

Perceived benefits refers to the degree to which new technologies provide more benefits than old ones [Lin and Lin, 2008]. This variable has been shown to impact technology adoption [Oliveira and Martins 2010; Banerjee and Golhar, 1994]. The firm must perceive that the adoption will either resolve existing problems or provide new business opportunities [Beatty et al., 2001], and capture the extent of agreement with claimed benefits relative to its local condition [Chau and Tam, 1997].

**H6.** Perceived benefits will have a positive effect on adoption of ISO.

## **3.3. Environment context**

### **3.3.1. Competitive pressure**

Competitive pressure is defined in the literature as the pressure resulting from a threat of losing competitive advantage [Lin and Lin, 2008]. It refers to the pressure of competition in the adoption of innovation [Gatignon and Robertson, 1989]. It is the industry in which the company operates that increases the likelihood of adoption of innovation [Thong, 1999; Kimberly and Evanisko 1981; Utterback, 1974]. The greater the competitive intensity, the greater is the technology adoption [Thong, 1999; Oliveira and Martins, 2010; Globerman, 1975; Levin et al., 1987; Gatignon and Robertson, 1989; Teo et al., 2003; Ngai et al., 2007]. Competitive pressure has been identified as an important determinant in the adoption of innovation [Grover, 1993; Gibbs and Kraemer, 2004]. Firms can simply follow their competitors in order to respond to pressure, regardless of the expected benefits, based solely on their success [Teo et al., 2003]. Increased competition makes firms feel the need to seek advantage compared to their peers, through innovation [Wang et al., 2010]. Thus, we propose the following hypothesis:

**H7.** Competitive pressure will have a positive effect on adoption of ISO.

### **3.3.2. Regulatory environment**

Regulatory environment is recognized as a critical factor affecting innovation. And while government policies that are too restrictive may cause a lower level of adoption of IT [Zhu and Kraemer, 2005], with the adoption of ISO we see it differently. The more restrictive the regulatory environment is, the more it is that firms will be willing to delegate management to an entity outside of their organization. The constant difficulty of adaptation for legal requirements can have a positive effect on ISO adoption. Thus, we propose the following hypothesis:

**H8.** Regulatory environment will have a positive effect on adoption of ISO.

## **3.4. Individual leader characteristics context**

### **3.4.1. Attitude toward change**

Attitude toward change describes the attitude of the leader, someone having the power of decision regarding change [Rogers, 1995]. The attitude has been shown to influence behavior [Ajzen and Fishbein, 1980], where the characteristics of the decision maker are crucial in determining the innovation [Rizzon, 1991]. So, too, the role played by the leader determines the capacity for innovation [Canon, 1985]. And although they may substantially influence the perception of innovation, the characteristics of the individual have been little explored in the literature [Wejnert, 2002]. Thus, we propose the following hypothesis:

**H9.** Attitude toward change will have a positive effect on adoption of ISO.

### 3.5. Control variables

In this study, we need to control for industry sector and firm age. It is common to see the use of control variables on information systems [Zhu et al., 2003; Zhu et al., 2006a], since they are used to control the variation of data that were not captured by the explanatory variables.

## 4. Research methodology

### 4.1. Construct measures

Our construction of items of measurement for the study of ISO adoption takes into account the existing instruments. However, some of the items used were adapted to the context of ISO. Table 4.1 summarizes all of the information about the items measuring the respective independent variables. All items were measured using a five-point Likert scale ranging from “(1) strongly disagree” to “(5) strongly agree”.

Table 4.1. *Measurement items*

Variables	Measurements items	Authors
<b>Complexity</b>	C1. Used complexity in integrating system.	Grover [1993]; Chang et al. [2007]; Premkumar and Roberts [1999]
	C2. Complexity in developing the system process	Grover [1993]; Chang et al. [2007]; Premkumar and Roberts [1999]
	C3. Degree of complexity in terms of work practices in operating the system	Bradford and Florin [2003]
<b>Relative advantage</b>	RA1. ISO adoption will lead to cost reduction	Li [2008]
	RA2. ISO adoption will lead to transaction acceleration	Li [2008]

	RA3. ISO adoption will provide timely information for decision making	Li [2008]
	RA4. ISO adoption will increase the business opportunities.	March and Ngai [2006]
	RA5. ISO adoption improves competitiveness.	March and Ngai [2006]
<b>Technology readiness</b>	TR1. Number of IT professionals located in my firm.	Zhu et al. [2006a]
	TR2. Technological capability of the company to adopt ISO.	Li [2008]
<b>Firm size</b>	FS1. Number of employees.	Cho [2006]; Gibbs and Kraemer [2004]; Hsu et al. [2006]
	FS2. Annual business volume.	Premkumar and Roberts [1999]
<b>Top management support</b>	TMS1. Top management supports the ISO adoption.	Li [2008]
	TMS2. Top management support is aware of the benefits of the ISO.	Li [2008]
	TMS3. Top management considers the ISO important for the organization.	Beatty [2001]
	TMS4. Top management encourages employees to use ISO.	Li [2008]
<b>Perceived benefits</b>	PB1. ISO may help improve the performance of my firm.	Yiu et al. [2007]
	PB2. ISO can save my firm time in managing their processes.	Yiu et al. [2007]
	PB3. ISO may offer a wider range of products to my firm.	Yiu et al. [2007]
	PB4. ISO may offer a greater number of services to my firm.	Yiu et al. [2007]
	PB5. ISO may offer good investment to my firm.	Yiu et al. [2007]
<b>Competitive pressure</b>	CP1. In our industry ISO adoption is useful to allow competition.	Chwelos et al. [2001]
	CP2. The leading firms in our industry are committed to the adoption of ISO.	March and Ngai [2006]
<b>Regulatory environment</b>	RE. The adoption of ISO, or the weighting, in my firm was promoted by measures taken by the government or other regulatory authorities.	Zhu et al. [2006a]
<b>Attitude toward change</b>	ATC1. For me the adoption of ISO is desirable.	Lee [2009]
	ATC2. When I am confronted with information, both positive and negative, on a new technology, I favor the positive information.	Gatignon and Robertson [1989]

The dependent variable, adoption, is dichotomous (0: non-adopter, 1: adopter), it was determined by asking respondents if their firms adopted ISO.

## 4.2. Data collection

A pilot test was conducted. A group of experts was formed to analyze each question and suggest improvements for the writing and questionnaire structure. Based on the follow-ups, we reviewed some of the texts of our original research questions. The pilot test provided the acceptable level of reliability required for all the items comprising the questionnaire.

The sample was obtained from a source list from Dun & Bradstreet, which is one of the world's leading sources of commercial information and insight on businesses. The sample was a random draw of firms from Portugal. In order to meet minimum standards for strata size class of firm, strata were to include a 20% share of large firms (>250 employees), 40% of medium-sized firms (50-250), and 40% of smallest-sized firms (< 50 employees). The survey was executed online, an invitation for participation was sent to several managers of the sample firms. The sample has 600 firms, a total of 261 usable responses were completed, yielding a total response rate of 43.5%. Table 4.2 shows the sample characteristics. About 80% of the data was collected from owners, managing directors, heads of IT, and other senior members of IT, suggest the high quality of the data source.

Table 4.2. *Sample characteristics*

	Number	Percentage		Number	Percentage
<b>Firm age:</b>			<b>ISO adoption:</b>		
< 10 years	48	18.4%	Yes	117	44.8%
11 – 20 years	74	28.4%	No	144	55.2%
21 - 50 years	93	35.6%			
> 51 years	46	17.6%			
			<b>Industry sector:</b>		
<b>Respondent's position:</b>			Manufacturing	73	28.0%
Owner/proprietor	6	2.3%	Commerce	35	13.4%

Managing director/board member	112	42.9%	Services	121	46.4%
Head of IT	8	3.0%	Construction	20	7.7%
Other senior member of IT	7	2.7%	Health	12	4.5%
Strategy development/organization	74	28.4%			
Other	54	20.7%	<b>Employee number:</b>		
			< 50	99	37.9%
			50-250	108	41.4%
			> 250	54	20.7%

#### 4.3. Instrument validation

A factor analysis was applied in order to assess the construct validation of the measures. Based on factor analysis with varimax rotation (with others rotations the results are similar) eight factors were obtained with eigenvalues greater than 1. These eight factors explain 83.6% of the total variance in the data. The Kaiser-Meyer-Olkin (KMO) test measures the adequacy of the sample. It returned a value of 0.87, revealing that the matrix of correlation is adequate for factors analysis [Sharma, 1996]. Table 4.3 presents only the loadings above 0.5. The results of the items that load higher than 0.50 on their associated factors, confirming the convergent validity of the factors [Chau and Tam, 1997]. The eight factors found were easily interpreted, they are: perceived benefits (PB), relative advantage (RA), top management support (TMS), complexity (C), technology readiness (TR), firm size (FS), attitude toward change (ATC), and competitive pressure (CP). These results are in accordance with the literature review.

Table 4.3. *Factor and validity analysis*

Variable	PB	RA	TMS	C	TR	FS	ATC	CP
PB1	0.755							
PB2	0.843							
PB3	0.848							
PB4	0.836							
PB5	0.836							
RA1		0.764						
RA2		0.776						
RA3		0.791						
RA4		0.859						
RA5		0.820						
TMS1			0.862					
TMS2			0.864					
TMS3			0.872					
TMS4			0.837					
C1				0.921				
C2				0.925				
C3				0.915				
TR1					0.994			
TR2					0.995			
FS1						0.896		
FS2						0.907		
ATC1							0.789	
ATC2							0.854	
CP1								0.909
CP2								0.687
Eigenvalue	4.16	3.99	3.56	2.63	2.02	1.66	1.44	1.43
% of variance explained	16.7%	16.0%	14.3%	10.5%	8.1%	6.6%	5.8%	5.7%

PB: perceived benefits; RA: relative advantage; TMS: top management support; C: complexity; TR: technology readiness; FS: firm size; ATC: attitude toward change; CP: competitive pressure.

Note: presented only loadings with absolute value greater than 0.5.

The factors proposed were evaluated for reliability, and as shown in Table 4.4, all coefficients are higher than 0.7, except for the factor attitude toward change, where the alpha value is 0.63. The alpha calculation is affected by the length of the construct [Thompson et al., 1991]. Thus, we attributed the lower reliability to the smaller number of items of the construct. As the reliability of at least 0.6 is acceptable for new scales [Nunnally, 1967; Chau and Tam, 1997], this construct was considered.

Table 4.4. *Reliability properties*

Variable	Cronbach's $\alpha$
Complexity (C)	0.917
Relative advantage (RA)	0.929
Technology readiness (TR)	0.997
Firm size (FS)	0.784
Top management support (TMS)	0.943
Perceived benefits (PB)	0.947
Competitive pressure (CP)	0.704
Attitude toward change (ATC)	0.628

In short, the measurement instrument is valid and reliable, and it can be used to test the proposed research model.

## 5. Data analysis and results

With the measurement instrument validated, and given the dichotomous characteristic of the dependent variable, we applied the logistic regression to test the research hypotheses. We began our analysis by checking the multi-collinearity, for which we calculated the variance inflation factor (VIF) [Oliveira and Martins, 2010]. The VIF ranged from a low of 1.05 to a high of 2.04. The values are below the threshold of 10, indicating that there is no problem of multi-collinearity among the variables [Hair et al., 1998].



The goodness-of-fit of the regression was assessed in four ways. First, to analyze the joint statistical significance of the independent variables we compute the likelihood ratio (LR) test, which is statistically significant ( $p\text{-value} < 0.01$ ). This implies a strong relationship between the dependent and independent variables. Second, we compute the two Pseudo  $R^2$  (cox and snell  $R^2 = 0.45$ , Nagelkerke  $R^2 = 0.60$ ), which yield satisfactory results. Third, we use the Hosmer-Lemeshow test [Hosmer and Lemeshow, 1980; Lemeshow and Hosmer, 1982], which reveals that there are no differences between fitted values of the model and the actual values ( $p\text{-value}$  is 0.15). Finally, the discrimination power of the model is evaluated in two ways. We use the area under the curve (AUC), which is equal to 90%, revealing an excellent discrimination [Hosmer and Lemeshow, 2000]. Table 5.1 shows that the logistic regression model is 81.2% accurate in its prediction. The adoption by random choices ( $[\text{adopters}/(\text{adopters} + \text{non-adopters})]^2 + [\text{non-adopters}/(\text{adopters} + \text{non-adopters})]^2$ ) would result in 50.5% for ISO adoption, which is much less than in the case of our regression. We therefore conclude that the logistic regression has much higher discriminating power than the random choice. The four statistical procedures reveal a substantive model fit, a satisfactory discriminating power, and there is evidence to accept an overall significance of the models.

Table 5.1. *Classification table*

	Predicted			Percent correct
	Total	Adopters	Non-adopters	
Adopters	144	121	23	84.0%
Non-adopters	117	26	91	77.8%
Overall				81.2%

The logistic regression results are presented in Table 5.2. To test the significance of regression coefficients of the independent variables the wald test was used. As is shown in Table 5.2, relative advantage, firm size, top management support, perceived

benefits, and competitive pressure factors were significant at the 5% level, and by the coefficients we see that they are positively related to ISO adoption. The other four factors are not statistically significant. Therefore, hypotheses H2, H4, H5, H6, and H7 are supported. Furthermore, it appears that the coefficients for the complexity, technological readiness, attitude toward change, and regulatory environment are not significantly different from zero.

Table 5.2. *Results of the logistic regression analysis*

Variable	B	Std. Error	Wald	Sig.
Complexity (C)	-0.263	0.189	-1.39	0.164
Relative advantage (RA)	0.495	0.201	2.46	0.014
Technology readiness (TR)	-0.356	0.326	-1.09	0.275
Firm size (FS)	1.126	0.525	2.15	0.032
Top management support (TMS)	0.593	0.189	3.13	0.002
Perceived benefits (PB)	1.575	0.244	6.45	0.000
Competitive pressure (CP)	1.425	0.223	6.38	0.000
Regulatory environment (RE)	0.231	0.225	1.02	0.307
Attitude toward change (ATC)	-0.336	0.204	-1.65	0.100

## 6. Discussion

The aim of this study is to understand the factors that influence the ISO adoption. Based on the combination of the TOE framework and DOI theory, we have tested nine hypotheses. First, we find relative advantage, firm size, top management support, perceived benefits, and competitive pressure to be significant facilitators of ISO adoption. Among them, perceived benefits is the strongest driver, followed by competitive pressure. All of these drivers are positively related. Relative advantage is positively related and the adoption of new technologies requires top management support [Pan and Jang, 2008; Lee, 2009]. Competitive pressure plays a stimulating role [Zhu et al., 2003; Hong and Zhu, 2006] in which larger firms are more likely to adopt

ISO [Zhu et al., 2003; Quadros et al., 2001; Majumdar, 1995], if the clear and tangible benefits are perceived [Cho, 2006]. This finding, which is based on the logistic regression results (Table 5.2), shows us that hypotheses H2, H4, H5, H6, and H7 are supported. Second, complexity, technology readiness, regulatory environment, and attitude toward change are insignificant in terms of affecting ISO adoption, i.e., H1, H3, H8, and H9 are rejected. The fact that complexity is an insignificant discriminator is corroborated in earlier studies [Low et al., 2011; Chau and Tam, 1997], although others support the opposite belief [Thong, 1999; Wang et al., 2010]. However, one acceptable explanation for this factor not being significant might have to do with the fact that, despite the adoption of ISO bringing innovation to the firm, as it may put the most current IT tools at the firm's disposal, these are the responsibility of a third entity, which may reflect a lack of concern about a possible complexity. Technology readiness' insignificance stands at odds with findings reported in earlier studies [Zhu et al., 2006a] and the explanation may reside in the fact that although the firm may be equipped with IT infrastructure and human resources with expertise in the management of the business processes, as we had the opportunity to verify before, perceived benefits in ISO adoption assume a high degree of importance and in a way leads the company to disregard those existing assets in favor of capturing the perceived benefits. Regulatory environment insignificance also contrasts with earlier studies finding that this factor tends to play a greater role [Zhu et al., 2004]. This means that legal issues that restrict the industry activity do not trigger the need for the firm's ISO adoption in such a way that overcomes a possible difficulty to adapt business processes to a new legal or regulatory requirement. The explanation might be that in some way firms are able to accommodate these new realities in their structure, and adapt to the restrictions of their own industry. Attitude toward change was found to be insignificant, and as the literature reports that the individual's decision is influenced by organizational elements [Illegems et al., 2001], perhaps the leader of the client firm lacks the strength to affect ISO adoption by him/herself. This is a decision that can disrupt the structure of the firm, and therefore, the decision tends to be shared rather than given to a single individual. Third, as indicated in Table 5.2, all factors that comprise the organizational context were found to be significant and positively related to ISO adoption. Compared with the remaining contexts, the organizational context is the most important in explaining ISO adoption.

This finding is in accordance with earlier studies concluding that mainly the organizational characteristics were decisive for the extent of ISO adoption [Thong, 1999]. Earlier studies also report that firms should make a strategic choice concerning the types of cooperative relationship needed to effectively strengthen their technological capabilities [Kim et al., 2010]. Fourth, the combination of the TOE framework and DOI theory reveals the non-applicability of DOI theory for this study and the superior applicability of the TOE framework. However, only one context of the DOI theory was used, and as we had the opportunity to observe in the literature review, there are some points of similarity between the DOI theory in Rogers [1995] and the TOE framework in Tornatzky and Fleisher [1990]. This indicates that, although for this study only the TOE framework applicability was observed, given their similarity and the fact that DOI theory has more variables that were not used, we neither discredit its value nor exclude its use in future studies that use other variables. Finally, our study has some important implications for managers and academics. The results suggest that managers and academics should focus on the organizational context of the ISO adoption process. For its implementation to succeed, it will be necessary for managers to give more importance to the organizational factors and ensure that all requirements are properly fulfilled. This is especially true for firms that equate its adoption and for suppliers. They can, in this way, segment the market in order to be more effective in achieving their objectives. They will no longer need to focus so much on the technological, individual, or environmental aspects, but may try to understand within their portfolio of potential customers, which firms are in accordance with organizational factors mentioned in this study. Academics can benefit from the results, given that future studies could focus on the factors that comprise the organizational context.

## **7. Conclusion**

In order to study the factors that explain the adoption of ISO, we have proposed a conceptual model based on a combination of the TOE framework and DOI theory. We used a sample of 261 Portuguese firms, and demonstrated the utility of TOE for

identifying the drivers of ISO adoption [Zhu et al., 2003; Zhu et al., 2004]. Although the combination of TOE with DOI theory proved to be less elucidating than hoped, we found that the application of the TOE framework was, indeed, useful. We identified five determinants of ISO adoption and demonstrated that they are essentially referents to only one context, the organizational. These findings may prove useful to serve as a beginning point for refining the TOE framework in future research. Finally, the instruments used in this study were largely validated by the application of several validity tests – findings that will also be of use in future research.

The study has some limitations. First, it is based on data from a single country, and the findings therefore may not be sufficient to extended to the entire business community. For the sake of consistency of our results, other countries should be examined, too. Second, many variables were found in the literature that might easily serve the conceptual model proposed. We have selected for inclusion the ones that in our view best pertained to the subject under study. However, we do not exclude the possibility of adding other variables to the model in order to improve it. Third, this study does not differentiate the adoption of ISO by industry, which might be important, and making such a distinction would surely improve our understanding of the subject. For further research, we suggest undertaking a comparative study of the adoption of ISO in different settings and/or sectors, such as the financial and human resources industries, in order to explore the differences between them. Also, it would be interesting to expand the focus of the study to include more countries and compare the findings with those of the present study, thereby gaining a deeper understanding of the topic.

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